2104 Annual Report
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Grant Number: N00014-13-1-0550
Title: Factors Limiting Power Output of Benthic Microbial Fuel Cells: Mechanistic and Ecological Studies

Scientific and Technical Objectives

The power output of benthic microbial fuel cells needs to be increased for many desired applications. To date, the development of strategies for power optimization has been largely empirical because there is a poor understanding of: 1) the function of the current-producing cells on anode surfaces and 2) the factors controlling the activity of natural current-producing biofilms harvesting current from marine sediments. Furthermore, we recently have identified sediment conductivity as another parameter influencing power output. Therefore, the objectives of these studies are to 1) elucidate the mechanisms for conductivity in the pili that contribute to biofilm conductivity, and thus current production; 2) determine the physiological and ecological factors controlling current production in biofilm communities in benthic microbial fuel cells; and 3) elucidate the mechanisms for long-range electron conduction through marine sediments.

Approach

(b) (4)

Concise Accomplishments

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Expanded Accomplishments

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Figure 1. Optical image of nanoelectrodes.

For electrical connections, contact pads on the device were wire bonded to the measuring instrument via a chip (Fig. 2). All the measurements were with a Keithley 4200S semiconductor parameter analyzer at ambient conditions.

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Work Plan

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Major Problems/Issues
None

Technology Transfer
Snorkel and sensor concepts that were derived from the previous related grant are now being further developed in collaboration with the American Petroleum Institute and private industry.

Foreign Collaborations and Supported Foreign Nationals
(b)(6)

Productivity

Peer-Reivewed Publications

Liu X, Tremblay P-L, Malvankar NS, Nevin KP, Lovley DR, Vargas M. 2014. A Geobacter sulfurreducens strain expressing Pseudomonas aeruginosa type IV pili localizes OmcS on pili but Is deficient in Fe(III) oxide reduction and current production. Applied and environmental microbiology 80:1219-1224.

Malvankar NS, Lovley DR. 2014. Microbial nanowires for bioenergy applications. Curr Opin. Biotechnol. 27:88-95.

Smith JA, Tremblay P-L, Shrestha PM, Snoeyenbos-West OL, Franks AE, Nevin KP, Lovley DR. 2014. Going wireless: Fe(III) Oxide reduction without pili by Geobacter sulfurreducens strain JS-1. Applied and environmental microbiology 80: 4331-4340.

Malvankar NS, King GM, Lovley DR. 2014. Centimeter-long electron transport in marine sediments via conductive minerals. ISME J. (in press).

Presentations at Scientific Meetings (* indicates invited talk)

Going Wireless: Fe(III) Oxide Reduction without Pili by *Geobacter sulfurreducens* Strain JS-1. Applied and Environmental Gordon Research Conference. Mount Holyoke College, MA. July 2013.

Impact of Single Amino Site Directed Mutagenesis of PilA on Extracellular Electron Transfer in *Geobacter sulfurreducens*. Annual Meeting of the American Society for Microbiology. Boston, MA. May 2014.

*Synthetic Electromicrobiology. North American Meeting of the International Society for Microbial Electrochemical Technologies. Penn State University. May 2014.

Multiple invitations to present keynote addresses at international meetings were declined due to personal restrictions on travel by the PI in this year.

Patents

None

Awards
Lovley-“Highly Cited Researcher 2014” -Thomson Reuters

Award Participants
Derek Lovley
Kelly Nevin
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